WHAT IS CLAIMED IS:

1. A method for determining the position of an edge to be measured of a pattern element on a substrate, in which a one-dimensional measured intensity profile is ascertained from a camera image of the edge and the position p of the edge relative to a reference point is determined therefrom, comprising the steps:
   a) ascertaining and storing a complete, nonlinear model intensity profile, which identifies the edge to be measured, of a model edge;
   b) defining with subpixel accuracy a desired model edge position x_k in the model intensity profile;
   c) acquiring a camera image, made up of pixel rows and pixel columns, of the edge to be measured;
   d) placing a rectangular measurement window onto the camera image transversely over the edge;
   e) determining from the image signals of the pixels of the measurement window a one-dimensional measured intensity profile of the edge;
   f) identifying the model intensity profile in the measured intensity profile with an indication of its location x_m relative to a reference point; and
   g) determining with subpixel accuracy the position p, referred to said reference point, of the edge to be measured, as $p = x_m + x_k$.

2. The method as defined in Claim 1,
   comprising the following further steps:
   a) mathematically and virtually displacing the model intensity profile on the measured intensity profile in one-pixel steps to notional positions x_j (j = pixel index) placed relative to the reference point, pixel j indicating the notional location of the first intensity value of the model intensity profile, and determining a discrete correlation value Kj for each notional position x_j that is assumed;

b) preparing from the discrete Kj values a correlation function K(x), where $K_j \approx K(x)$ at pixels j;

c) determining with subpixel accuracy the local maxima of the correlation function K(x);

d) rejecting those local maxima of the correlation values K_j that were caused by intensity curves in the noise; and

e) determining the desired edge position p from the remaining local maximum x_m that was caused by the edge to be measured, as $p = x_m + x_k$.

3. The method as defined in Claim 1, comprising the following further steps:

a) mathematically and virtually displacing the model intensity profile on the measured intensity profile in one-pixel steps to notional positions x_j (j = pixel index) placed relative to the reference point, pixel j indicating the notional location of the first intensity value of the model intensity profile, and determining a discrete correlation value Kj for each notional position x_j that is assumed;

b) preparing from the discrete Kj values a correlation function K(x), where $K_j \approx K(x)$ at pixels j;

c) taking the derivative $\Delta K(x)$ of the correlation function K(x) and determining the zero points of the derivative $\Delta K(x)$;

d) rejecting those zero points that were caused by intensity curves in the noise; and

e) determining the desired edge position p from the remaining zero point x_m that was caused not by the noise but by the edge to be measured, as $p = x_m + x_k$.

4. The method as defined in Claim 1, comprising the following further steps:

a) mathematically and virtually displacing the model intensity profile on the measured intensity profile in one-pixel steps to notional positions x_j (j = pixel index) placed relative to the reference point, pixel j indicating the notional location of the first intensity value of the model intensity profile, and determining a discrete correlation value Kj for each notional position x_j that is assumed;

b) preparing one or more local parabolic fits for all discrete K_j values that lie above a defined limit value for the K_j values;

c) determining with subpixel accuracy the local maxima of the parabolic fits;

d) rejecting those local maxima that were caused by intensity curves in the noise; and

e) determining the desired edge position p from the remaining local maximum x_m that was caused by the edge to be measured, as $p = x_m + x_k$.

5. The method as defined in Claim 1, comprising the following further steps:

a) mathematically and virtually displacing the model intensity profile on the measured intensity profile in one-pixel steps to notional positions x_j (j = pixel index) placed relative to the reference point, pixel j indicating the notional location of the first intensity value of the model intensity profile, and determining a discrete correlation value Kj for each notional position x_j that is assumed;

b) creating the gradient $\Delta K_j = K_j - K_{j+1}$ for each K_j value;

c) creating a respective straight-line fit in the vicinity of all possible zero points, the straight-line fit being accomplished in each case with a group of ΔK_j values of which at least one ΔK_j value is greater than zero and one less than zero;

d) determining the zero points of the straight-line fits;

e) rejecting those zero points that were caused by intensity curves in the noise; and

f) determining the desired edge position p from the remaining zero point x_m that was caused not by the noise but by the edge to be measured, as $p = x_m + x_k$.

6. The method as defined in Claim 1,
comprising the following further steps:

a) mathematically and virtually displacing the model intensity profile on the measured intensity profile in one-pixel steps to notional positions x_j (j = pixel index) placed relative to the reference point, pixel j indicating the notional location of the first intensity value of the model intensity profile, and determining a discrete correlation value Kj for each notional position x_j that is assumed;

b) preparing one or more local parabolic fits in the vicinity of those discrete correlation values K_j whose adjacent correlation values K_{j-1} and K_{j+1} have lower values;

c) determining with subpixel accuracy the local maxima of the parabolic fits;

d) rejecting those local maxima that were caused by intensity curves in the noise; and

e) determining the desired edge position p from the remaining local maximum x_m that was caused by the edge to be measured, as $p = x_m + x_k$.

7. The method as defined in Claim 2,
characterized by calculation of the correlation values K_j in accordance with

$$K_j = \frac{N\sum_{i=1}^{N}\left(P_{i+j}M_i\right) - \left(\sum_{i=1}^{N} P_{i+j}\right)\left(\sum_{i=1}^{N} M_i\right)}{\sqrt{\left(N\sum_{i=1}^{N}\left(P_{i+j}\right)^2 - \left(\sum_{i=1}^{N} P_{i+j}\right)^2\right)\left(N\sum_{i=1}^{N} M_i^2 - \left(\sum_{i=1}^{N} M_i\right)^2\right)}}$$

in which

- P indicates an intensity value of a pixel of the measured intensity profile;
- M indicates an intensity value of a pixel of the model intensity profile; and
- i = 1 ... N indicates the pixels of the model intensity profile,

and in which

- j identifies that pixel in the measured intensity profile at which the first pixel i = 1 of the model intensity profile for the respective instantaneous notional position lies on the measured intensity profile.

8. The method as defined in Claim 1,
wherein the model intensity profile is ascertained using the following steps:
a) acquiring a camera image, made up of pixels arranged in rows and columns, of a model substrate having a model edge, with the same optical measurement parameters that are to be used subsequently when measuring the edge to be measured that is identifiable by way of the model edge;
b) placing a rectangular measurement window onto the camera image of the model substrate;
c) determining from the image signals of the pixels of the measurement window a one-dimensional intensity profile of the model substrate;
d) taking from that intensity profile, as the model intensity profile, a nonlinear partial area identifying the model edge.

9. The method as defined in Claim 1,
wherein the model intensity profile is ascertained by mathematical simulation of the model edge.

10. The method as defined in Claim 1,
wherein measurement of the position of at least two edges that are mirror-symmetrical with respect to one another is accomplished by way of the following method steps:
  a) ascertaining and storing a complete, nonlinear first model intensity profile identifying one of said edges;
  b) determining the position of at least one edge by means of the first model intensity profile;
  c) mirror-reflecting the first model intensity profile and storing the reflected first model intensity profile as a second model intensity profile associated with a notional reflected model edge;
  d) determining by means of the second model intensity profile the position of at least one edge that is mirror-symmetrical to those already measured.

11. The method as defined in Claim 1,
comprising the following steps:
  a) ascertaining and storing several different nonlinear model intensity profiles for different model edges;
  b) defining a desired edge position x_k with subpixel accuracy in each one of the model intensity profiles;
  c) determining a one-dimensional measured intensity profile of a substrate having several edges to be measured whose model intensity profiles have previously been determined;
  d) identifying the various model intensity profiles in the measured intensity profile, such that for each model intensity profile found in the

measured intensity profile, its position x_m relative to the reference point is indicated; and

e) separately calculating, with subpixel accuracy, the position p of each edge identified by means of its associated model intensity profile, as $p = x_m + x_k$.

12. The method as defined in Claim 1,
comprising the following steps:
    a) ascertaining and storing several different nonlinear model intensity profiles for different model edges;
    b) defining a desired edge position x_k with subpixel accuracy in each one of the model intensity profiles;
    c) determining a one-dimensional measured intensity profile of a substrate having several edges to be measured whose model intensity profiles have previously been determined;
    d) identifying in the measured intensity profile, from among the various model intensity profiles previously ascertained, the correct model intensity profile associated with the edge to be measured, such that for each model intensity profile found in the measured intensity profile, its position x_m relative to the reference point is indicated; and
    e) calculating, with subpixel accuracy, the position p of each edge identified by means of its associated model intensity profile, as $p = x_m + x_k$.

13. A measuring instrument for determining the position of an edge (7) to be measured of a pattern element on a substrate (8), which comprises an incident illumination device (10, 13), an imaging device (10), a camera (14) for acquiring a camera image of the edge to be measured, a horizontally X-Y displaceable measurement stage (4) for receiving the substrate (8), means for placing a rectangular measurement window onto the camera image

transversely over the edge, means for determining from the image signals of the pixels of the measurement window a one-dimensional measured intensity profile of the cross section of the edge, and means for determining the position p of the edge relative to a reference point,
characterized by:

a) means for ascertaining and storing a complete, nonlinear model intensity profile, which identifies the edge to be measured, of a model edge;
b) means for defining with subpixel accuracy a desired edge position x_k in the model intensity profile;
c) means for identifying the model intensity profile in the measured intensity profile with an indication of its location x_m relative to a reference point; and
d) means for determining with subpixel accuracy the position p, referred to said reference point, of the edge to be measured, as $p = x_m + x_k$.

14. The measuring instrument as defined in Claim 13, wherein the measurement stage (4) is configured as an open frame for receiving a transparent substrate (8), and there is provided below the measurement stage (4) a transmitted-light illumination device (15,16) whose optical axis aligns with the optical axis of the incident illumination device (10, 13).

15. The measuring instrument as defined in Claim 13, wherein the means for ascertaining and storing a model intensity profile, the means for defining a desired edge position x_k, the means for identifying the model intensity profile in the measured intensity profile, and the means for determining the position p of the edge to be measured, comprise at least one computer (29) and at least one computer program for carrying out the method steps as defined in Claim 1.

16. A computer program product having program code means, which, in the context of a measuring instrument (6) for determining the position of an edge (7) to be measured of a pattern element on a substrate (8), controls and performs the following method steps

    a) ascertaining and storing a complete, nonlinear model intensity profile, which identifies the edge (7) to be measured, of a model edge;

    b) defining with subpixel accuracy a desired model edge position x_k in the model intensity profile;

    c) acquiring a camera image, made up of pixel rows and pixel columns, of the edge (7) to be measured;

    d) placing a rectangular measurement window onto the camera image transversely over the edge (7);

    e) determining from the image signals of the pixels of the measurement window a one-dimensional measured intensity profile of the edge (7);

    f) identifying the model intensity profile in the measured intensity profile with an indication of its location x_m relative to a reference point; and

    g) determining with subpixel accuracy the position p, referred to said reference point, of the edge to be measured, as $p = x_m + x_k$

    when the computer program is executed on a computer which is associated with the measuring instrument (6).